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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/536,993	05/31/2005	Toshitsugu Sakamoto	8017-1169	9950

466 7590 08/09/2007
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EXAMINER

CRUZ, LESLIE PILAR

ART UNIT	PAPER NUMBER
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2826

MAIL DATE	DELIVERY MODE
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08/09/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/536,993	Applicant(s) SAKAMOTO ET AL.	
	Examiner Leslie P. Cruz	Art Unit 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 May 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10, 20, 21 and 27-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 27-29 is/are allowed.
- 6) ☒ Claim(s) 1-10, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to:
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.



Minhloan Tran
Primary Examiner
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Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 5/31/2005 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>5/22/2007</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Acknowledgements

The amendment filed on 18 May 2007 in response to the Office Action mailed on 18 January 2007 has been entered. The present Office Action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office Action are claims 1-10, 20-21 and 27-29.

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "substrate" recited in line 3 of claim 6 in combination with "insulating film" recited in line 3 of currently amended claim 2 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet"

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pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is unclear where the "barrier metal layer", recited in line 10, is located.

Claim 2 recites the limitation "barrier metal layer" in line 10. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 3, 5, 7, 9 & 20 are rejected under 35 U.S.C. 102(e) as being anticipated by

Haase (US 2003/0211724 A1).

With respect to claim 1, Haase (Figs. 1 & 2) discloses a semiconductor device comprising a connection plug [40] defined by a via hole filled with a metal [34b] and comprising a nanomaterial [32, 48] surrounded by the metal, wherein the nanomaterial is substantially uniformly disposed in a section of the via hole, and the metal both surrounds the nanomaterial and filled the via hole [paragraph 0021].

With respect to claim 3, Haase discloses the semiconductor according to claim 1. Haase further discloses the nanomaterial is a fibrous carbon nanomaterial or a particle-like carbon nanomaterial [paragraph 0015].

With respect to claim 5, Haase discloses the semiconductor according to claim 1. Haase (Figs. 1 & 2) further discloses the nanomaterial is oriented substantially perpendicularly to a substrate [16, paragraph 0020].

With respect to claim 7, Haase discloses the semiconductor according to claim 1. Haase (Fig. 1) further discloses the nanomaterial is provided in the whole connection plug.

With respect to claim 9, Haase discloses the semiconductor according to claim 1. The limitation “the metal is formed by an MOCVD method or a plating method” is a product by process limitation and is not given patentable weight. Therefore, claim 9 is not patentably distinguishable over the Haase reference. See note below.

With respect to claim 20, Haase discloses the semiconductor according to claim 1. Haase (e.g. Figs. 1, 4, 5D & 6) further discloses the connection plug is formed from a metal [18] containing a nanomaterial [paragraph 0076]. The limitation “metal is formed by a plating method which involves a plating liquid” is a product by process limitation and is not given

patentable weight. Therefore, claim 20 is not patentable distinguishable over the Haase reference. See note below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 2, 4, 6, 8, 10 & 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haase.

With respect to claim 2, Haase (Figs. 1 & 2) discloses a semiconductor device comprising: an insulating film [20]; an interlayer dielectric film [26] on the insulating film; A trench [24] within the dielectric film; an interconnection [40] comprising a metal layer filling [34b] on the trench; particles of metal [42] on a lower horizontal surface of the metal layer [30]; nanotubes [32, 48] formed on the metal particles and mixed in the metal layer, wherein the nanotubes are of a nanomaterial is substantially uniformly formed on a bottom surface of the interconnection [paragraph 0015, 0021]. Haase discloses the metal layer [30] may include tungsten or an immersed layer of cobalt silicide, nickel silicide or titanium silicide. Haase does not specify the metal layer [30] is a barrier metal layer. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the metal layer [30] of Haase to be a barrier metal layer in order to prevent the particles of metal from diffusing into the

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insulating layer or interlayer dielectric film. Note Column 3 lines 24-28 of Yamaha (US 5,036,382) is cited to support for this well known position.

With respect to claim 4, Haase discloses the semiconductor device according to claim 2. Haase further discloses the nanomaterial is a fibrous carbon nanomaterial or a particle-like carbon nanomaterial [paragraph 0015].

With respect to claim 6, Haase discloses the semiconductor device according to claim 2. Haase (Figs. 1 & 2) further discloses the nanomaterial is oriented substantially perpendicular to a substrate [16, paragraph 0020].

With respect to claim 8, Haase discloses the semiconductor device according to claim 2. Haase (Figs. 1 & 2) further discloses the nanomaterial is provided up to the vicinity of a top surface of the interconnection.

With respect to claim 10, Haase discloses the semiconductor device according to claim 2. The limitation “the metal is formed by an MOCVD method or a plating method” is a product by process limitation and is not given patentable weight. Therefore, claim 10 is not patentably distinguishable over the Haase reference. See note below.

With respect to claim 21, Haase discloses the semiconductor according to claim 2. Haase further discloses the interconnection is formed from a metal containing a nanomaterial [paragraph 0015]. The limitation “metal is formed by a plating method which involves a plating liquid” is a product by process limitation and is not given patentable weight. Therefore, claim 20 is not patentable distinguishable over the Haase reference. See note below.

Product by Process

Note that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and *In re Marosi et al.*, 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above case law makes clear. See also MPEP § 706.03(e).

Allowable Subject Matter

Claims 27-29 are allowed over the prior art of record.

The following is an examiner's statement of reasons for allowance:

The prior art of record taken either singly or in combination fails to anticipate or fairly suggest the limitations which the Applicant claims in claims 27-29 in a manner which would warrant a rejection under 35 U.S.C. § 102 or 35 U.S.C. § 103.

There was no prior art found by the examiner that suggested modification or combination with the cited prior art so as to satisfy the combination of the present independent claim 27; especially, the prior art does not provide a barrier metal layer coating a bottom and sides of the trench, the barrier metal layer located intermediate the metal layer and the dielectric film with the

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barrier metal layer separating the metal layer from the dielectric film in combination with carbon tubes formed on the metal particles and mixed in the metal layer as recited in claim 27.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Response to Arguments

Applicant's arguments filed 18 May 2007 have been fully considered but they are not persuasive. Applicants argue Awano (US 2002/0163079 A1) and Haase (US 2003/0211724 A1) does not teach or suggest a via hole filled with a metal and comprising a nanomaterial surrounded by the metal [claim 1]. However, Figs. 1 and 2 of Haase teaches a via hole [24] filled with a metal [34b] and comprising a nanomaterial [32, 48] surrounded by the metal. Paragraph 0021 of Haase further teaches the metal [34b] "may be deposited such that it substantially surrounds second ends 48 of carbon nanotubes 32, possible extending into via 24 so as to substantially surround second ends 48 even of any carbon nanotubes 32 whose second ends 48 do not project out of via 24." Applicants also argue Awano and Haase does not teach or suggest a trench within a dielectric film, a metal layer filling on the trench, nanotubes formed on metal particles and mixed in the metal layer [claim 2]. However, Figs. 1 and 2 of Haase teaches a trench [24] within a dielectric film [26], a metal layer [34b] filling on the trench, nanotubes [32, 48] formed on metal particles [42] and mixed in the metal layer. Paragraph 0015 of Haase further teaches "conductive layer 34 encompasses carbon nanotubes 32 being coupled to and

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extending from corresponding catalyst nanoparticles deposited on active region 22 (for example, on layer30).” Therefore, claims 1 and 2 do not distinguish over the Haase reference.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action:

Telephone/Fax Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leslie P. Cruz whose telephone number is 571-272-8599. The examiner can normally be reached on Monday-Friday 9:00-5:30.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisors, Sue A. Purvis can be reached on 571-272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.


lpc

Leslie Pilar Cruz
Examiner
Art Unit 2826